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(58) Field of search
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Selected US specifications from IPC sub-classes B29C B29D B29L

(54) Extruding a plastic tube incorporating perforate reinforcement

(57) A perforate e.g. metal, tape-like blank (4) is rolled at station (AB-CD) into a tubular configuration, the adjacent edges are elastically separated at station (EF), for insertion of a mandrel (11) within the tube, the edges are then joined together around the mandrel (11) at station (GH) either by mechanically interlocking or by welding, and the tubular reinforcement than passes on the mandrel (11) through an extrusion head (13, 14) at which plastic inner and outer layers are extruded onto the reinforcement, to be integrally connected together through the perforate structure. The tube may convey gas or liquid and the reinforcement may transmit electrical signals or current. The plastic layers may be metal, wood, glass, or textile, fibre reinforced inner layers adjacent the reinforcement, and outer layers of a gas impermeable ethylene-vinylalcohol copolymer. The reinforcement may be guided throgh the head, by engagement of toothed wheels with the perforate structure, and the adjacent rows of perforations may be staggered to enable continuous engaging delivery by adjacent toothed wheels.

FIG. 1

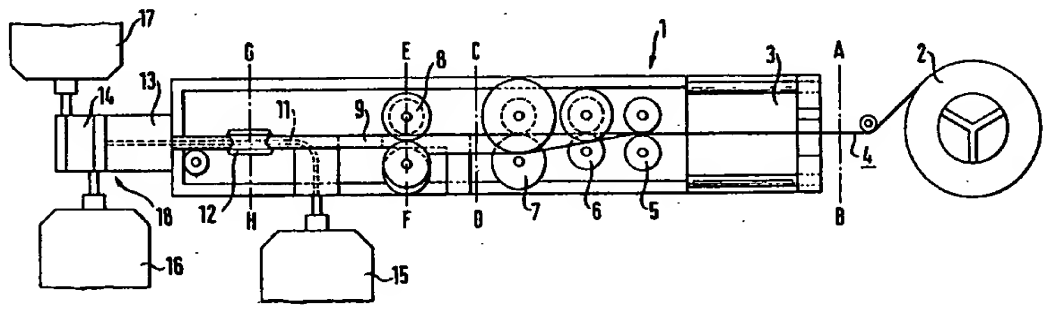

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FIG. 1

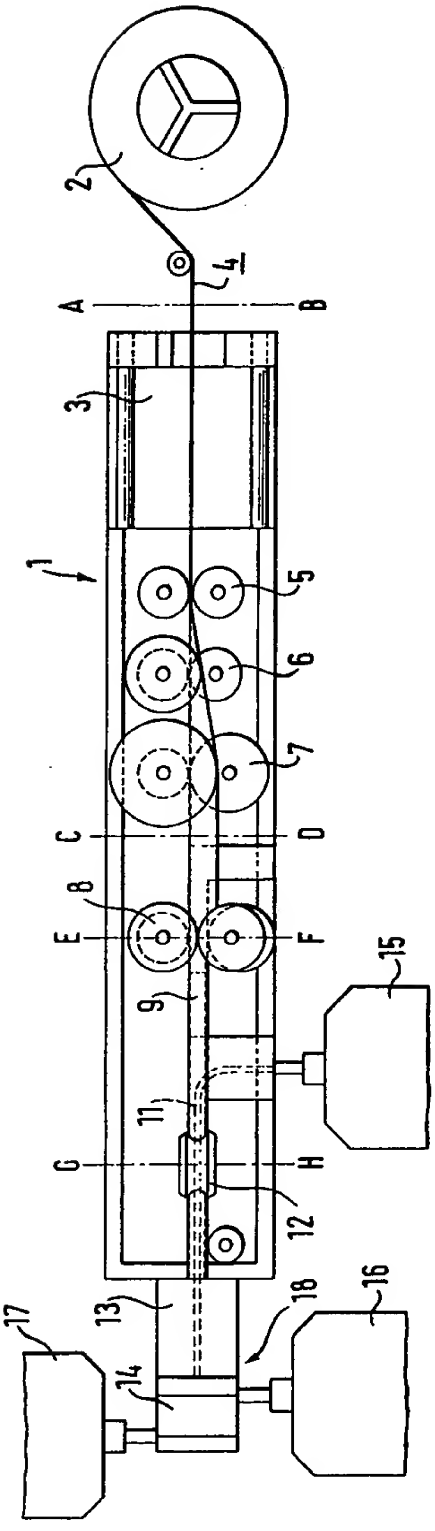

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FIG. 2

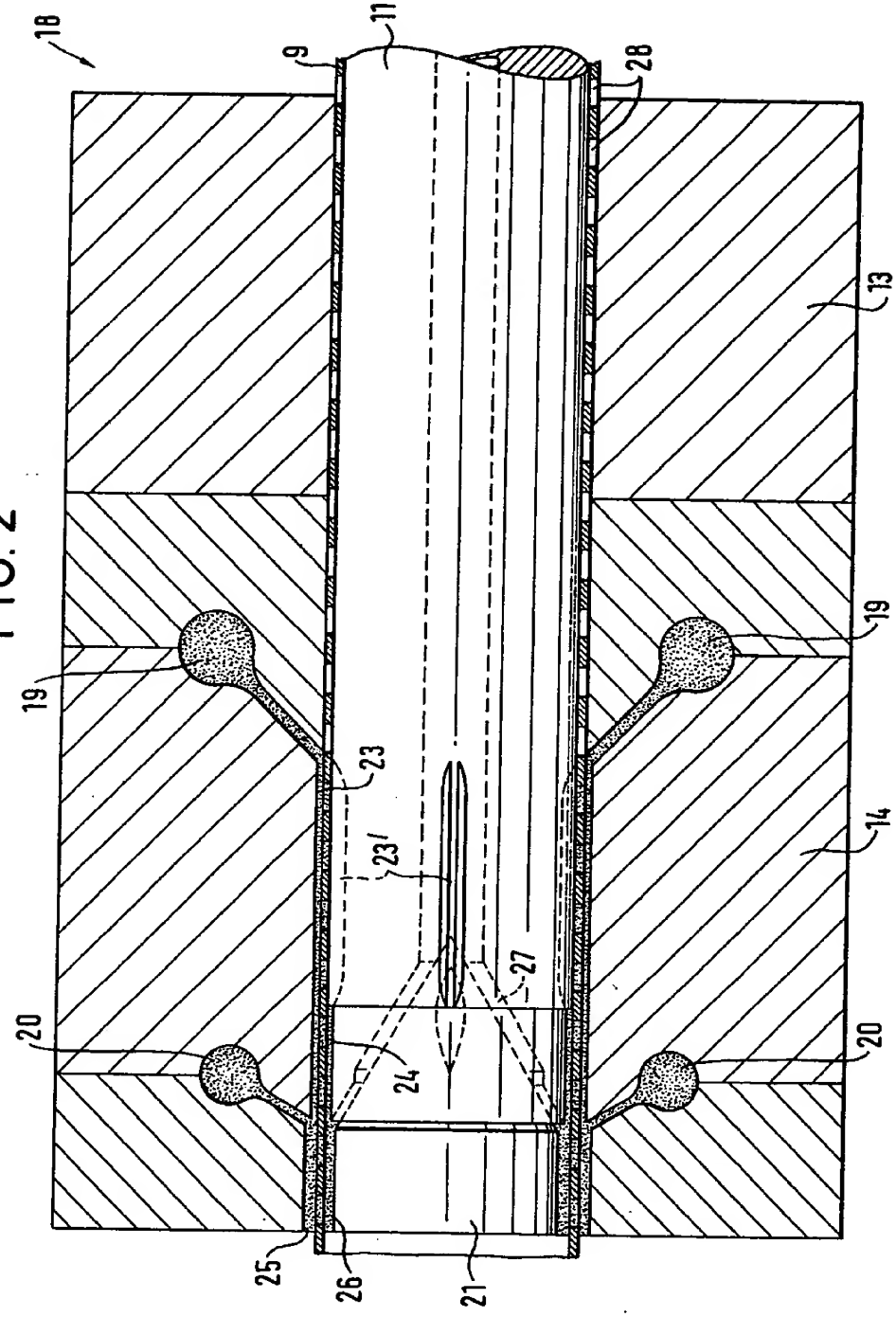

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FIG. 3

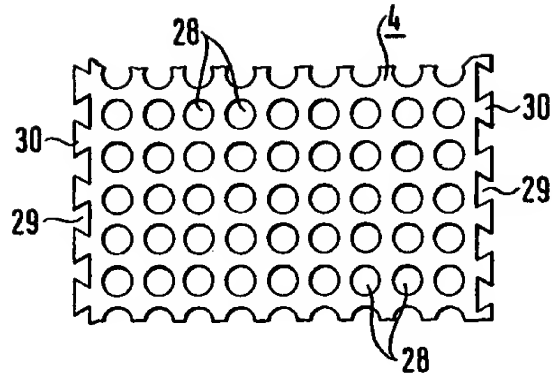
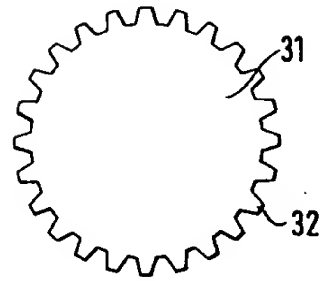


FIG. 4



SPECIFICATION

A method for manufacturing reinforced hollow profile members and a device for carrying through this method

This invention relates to a method for manufacturing reinforced hollow profile members according to which an elongated reinforcement element is introduced into an extrusion head and the reinforcement element is diecasted from all sides by a hardenable plastic material, and also a device for carrying through this method. It is already known to equip a hollow profile member with a reinforcement element in order to increase as well the tensile strength as also the bending strength thereof in particular if the material of the hollow profile member is relatively soft and is for example comprised of a plastic material and if the hollow profile member is diecasted.

Since a hollow profile member normally is closed on all sides until now it was only possible to use a strip like or rod like reinforcement element or a wire like material which has been introduced into the nozzle area of an extrusion head so as to diecast the reinforcement element with plastic material from all sides.

However, there exists also a great demand for reinforced hollow profile members with which the reinforcement elements are not only comprised of reinforcement tapes or reinforcement rods but are comprised of reinforcement elements which have already a hollow profile like shape so as to basically increase the reinforcement effect. It is for example desirable that a hollow profile member which has a circular cross section as for example a tube contains a reinforcement element which has also a tube like shape so as to obtain an increased mechanical strength of such a hollow profile member.

It is therefore an object of the present invention to realize a method for manufacturing reinforced hollow profile members of the kind as defined above with which also reinforcement elements which have a comparatively complicated cross section shape can be embedded into the material of the hollow profile member in order to produce hollow profile members which have a basically increased mechnical strength and bending strength.

It is a further object of the present invention to provide a device for carrying through the inventive method and which is capable for manufacturing a reinforced hollow profile member in a continuous operation according to the extrusion method.

According to the present invention this object is solved in that

(a) a strip like blank or unfinished piece is rolled at a rolling station into a desired cross section shape, wherein the longitudinal rims of the so finished reinforcement piece or element are getting close one to the other or are contacting each other;

(b) then the finished reinforcement element is widened at the opposite arranged or contacting longitudinal rims so as to form a slot like opening with which said reinforcement element is elastically deformed;

(c) into said slot like opening a traction head (mandrel) is introduced;

(d) said widened slot like opening within said reinforcement element is closed again;

(e) the now again oppositely arranged or contacting longitudinal rims of said reinforcement elements are mounted one to the other;

(f) then said reinforcement element is introduced into a mechanical guiding portion of the extrusion head; and

(g) from outside through an outer nozzle arrangement and from inside through said traction head (mandrel) one or several layers of a plastic material is respectively are extruded on to said reinforcement element.

According to the inventive method for example a plastic tube can be manufactured which includes a tube like reinforcement element wherein such tube like reinforcement element is embedded from all sides into the plastic material. Such a tube is capable to withstand comparatively extremly high inner pressure but has still a very low weight and is in particular resistant against an erosion so that such a tube can be used for very different purposes for example as a hot water-and cold water tube.

In order to obtain a very continuous lamination on the reinforcement element according to the present invention the strip like unfinished piece (blank) is straightened within a straightening station before the deformation thereof within the rolling station.

The strip like unfinished piece suitably can be drawn off from a stock bobbin so that a continuous production of a hollow profile member according to the extrusion method is possible. The basis material for producing the reinforcement element is comprised of a tape like unfinished piece (blank) as for example a sheet strip which has a plurality of openings or through holes The longitudinal rims of the tape like blank can be provided with engaging projections and with engagement recesses associated to said engaging projections so that the rims can be hooked one into the other or can be mounted one to the other.

A further possibility consists in that the longitudinal rims of the reinforcement element are welded one to the other.

Furthermore the method according to the present invention can also be realized in that said reinforcement element is covered with several layers that means as well several outer layers as also several inner layers. According to the invention a first plastic-inner layer is introduced through an outer nozzle arrangement and through the openings of said rein-

forcement element onto the inner surface of the reinforcement element and this inner plastic-layer is then formed by means of said traction head (mandrel). A first plastic-outer layer and a first plastic inner-layer can be made suitably from the same plastic material and furthermore also a second plastic-outer layer and a second plastic-inner layer of the same plastic material can be provided. The inner layers suitably can be comprised of a fiber-plastic mixture in particular of a wood fiber-plastic mixture, whereas the second outer layer and/or the second inner layer suitably can be comprised of a gas tight plastic layer which has the function of a blocking layer so that such a multi layer hollow profile member can be used as a pipe in order to conduct gases, liquids and in particular hot water and cold water.

The cross section shape of the hollow profile member can be as well circular as also rectangular, but can also have any other cross section shape.

This invention also relates to a device for carrying through the inventive method which is characterized by

an extrusion plant comprising at the input side a straightening station in order to straighten a tape like blank, furthermore a rolling station following said straightening station and including several possibly inclined and displaced arranged pairs of rolls,

a widening station following to said rolling station in order to slot like widening the already finished reinforcement element with elastic deformation thereof

a hollow traction head (mandrel) inserted into said slot like opening, a closing station following to said widening station in order to close the reinforcement element which has been formed into the desired cross section shape, along the longitudinal rims thereof

a succeeding guiding station including several guiding elements which are circumferentially distributed around the reinforcement element and are engaging from outside so as to guide the reinforcement element in a desired position and an extrusion head which comprises a plurality of longitudinally succeeding nozzles, wherein at the range of said nozzles the head portion of said hollow traction head (mandrel) is arranged.

An improved dimension accuracy can be obtained in that according to the present invention said traction head is guided in the longitudinal direction before said nozzles at the inner wall of the reinforcement element.

Furthermore according to the present invention the guiding station is performed such that it can guide the reinforcement element nearly without any wear and is positioning it. This is realized with using guiding elements which are comprised of rotatably supported gear like disks the teeth of which are engaging into the openings of said reinforcement element wherein said gear like disks are engaging said reinforcement element circumferentially distributed so that this reinforcement element is maintained in position and additionally is very exactly guided with moving in the forward direction.

Further advantageous embodiments of the present invention are resulting from the subclaims.

In order that the invention may be fully understood some embodiments will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a schematic side view of an extrusion plant according to the present invention;

Figure 2 a partly cross section view of an extrusion head portion;

Figure 3 a portion of a tape like blank which can be used for manufacturing a reinforcement element; and

Figure 4 a side view of a gear-like disk which is used within the guiding station of the extrusion plant.

Fig. 1 shows a schematic side view of an extrusion plant according to the invention which is commonly designated with reference number 1. With using of this extrusion plant the method according to the present invention can be realized for continuously manufacturing reinforced hollow profile members.

The extrusion plant 1 comprises a stock bobbin 2, onto which a tape like blank 4 is wound. In Fig. 3 only a portion of the tape like blank 4 is shown. With the shown embodiment the blank 4 is comprised of a sheet strip which comprises a plurality of openings or through holes 28 which are arranged in longitudinal direction of the strip in the form of rows of openings which are arranged side by side. The outer rims of the tape like blank 4 are provided with locking projections 30 and with locking recesses 29 which are correspondingly shaped.

In the plant according to Fig.1 the tape like blank 4 is at first entering the straightening station 3 in which the tape like blank is straightened so as to obtain a flat sheet strip. From the straightening station 3 the blank is getting into a rolling station which is positioned at the portion AB–CD and comprises several pairs of rolls 5,6,7 in order to roll the tape like blank (4) into a desired cross section shape. The cooperating pairs of rolls 5, 6, 7 can be arranged so as to be displaced by an angle one relatively to the other in order to form different curvature portions within the sheet tape. At CD the then finished reinforcement element is leaving the rolling station, wherein with the embodiment shown the reinforcement element has been formed into a circular tube. The reinforcement element is always formed such that the two longitudinal rims provided with the teeth like engaging projections 30 opposing the correspondingly

shaped engaging or locking recesses 29 are contacting them. Within a succeeding widening station (8) (the plane EF) the finished reinforcement tube is then slot like widened so that the reinforcement tube is only elastically deformed. Within the range between GH and EF then into the slot like widened opening of the reinforcement element a traction head (mandrel) (11) is inserted which is extending forwardly up to the forward output end of the extrusion head 14.

The reinforcement element is then getting to a closing station 12 (the plane GH) in which the two longitudinal rims of the reinforcement element are moved one towards the other so as to cancel the slot like opening again and in which the two longitudinal rims are moved one over the other so as to insert the respective engaging projections 30 into the corresponding engaging or locking recesses 29. Now the reinforcement element has obtained its final form and shape and it is inserted in this form into the guiding station 13 in which circumferentially distributed gear-like disks are rotatably arranged wherein one of these disks is shown in Fig. 4 and hase reference number 31. The disk 31 has teeth like projections 32 at the outer circumference wherein the tooth pitch corresponds to the opening spacing (in longitudinal direction) of the strip like blank 4 respectively of the finally finished reinforcement element 9. These gear-like disks are arranged with their main planes in parallel to the longitudinal axis of the extrusion plant 1 and a plurality of those disks can be arranged in longitudinal direction in a succession and can also be circumferentially distributed so that the tube like reinforcement element 9 is brought into a predetermined position within the guiding station 13 and is introduced in this exact position into the extrusion head 14. The use of the gear-like disks 31 has the advantage that within the guiding station 13 nearly no friction is created so that the wear in this station is kept very small.

The opening rows extending in longitudinal direction can be alternately displaced in longitudinal direction which will result in that the teeth of the gear-like disks 31 are not engaging into the openings in synchronism and are leaving the openings in synchronism, but partly out of synchronism (in push-pull manner) which is contributing in avoiding the creation of vibrations which can be created during the transporting operation.

The tube like reinforcement element is then getting from the guiding station 13 into the extrusion head 14, which is schematically shown in Fig. 2 partly in cross section and also at an increased scale. The extrusion head comprises several disk like elements 13, 14 which are held together in axial direction by suitable mounting means (not shown). The extrusion head includes a first moulding nozzle 19 which is ring like extending around the reinforcement element 9 and which comprises an inclined extending slot like opening. Through the moulding nozzle 19 plastic material is moulded onto the outer surface of the tube like reinforcement element 9 wherein a portion of this plastic material is entering through the openings 28 (see Fig. 3) of the reinforcement element into the interior of the tube like reinforcement element. In Fig. 2 also the traction head (mandrel) 11 is schematically shown which can be guided at the range of the guiding station 13 at the inner surface of the tube like reinforcement element. The traction head 11 comprises at the front portion thereof a groove like recess 23' which is circumferentially extending and into which the plastic is entering which has been injected through the openings 28 by means of said moulding nozzle 19. This plastic is then formed into an inner layer 24 in view of the continuously enlarging shape of the traction head 11, wherein simultaneously also the outer layer 23 is formed so that the outer (first outer layer) 23 is made from the same material as that of the first inner layer 24 and is connected therewith (through the openings 28).

In the moving direction of the tube like reinforcement element 9 it follows then a second moulding nozzle 20 through which a second outer layer 25 is diecasted onto the first outer layer 23.

Through the hollow performed traction head 11 then through injection channels 27 from inside a second inner layer 26 is diecasted on said first inner layer 24 wherein the final form or shape on this second inner layer is obtained by the end portion 21 of the traction head (mandrel) 11. As can be seen from Fig. 2 the outer dimension (diameter) of the end portion 21 is somewhat smaller than the dimension (diameter) of the traction head 11 at the range of the guiding station 13.

Thus from the left hand end of the extrusion plant 1 a reinforced hollow profile member is emerging which can not be only produced in any desired length, but which has also special characteristics:

This hollow profile member can be produced so as to have a very thin wall and comprises several outer layers and several inner layers. The reinforcement element corresponds to the cross section shape of the hollow profile member so that this reinforcement element can be especially effective in order to obtain an increased mechanical strength in particular bending strength.

Of course the extrusion head 18 can also be equiped with more than two moulding nozzles 19 and 20 so that then the possibility is created to produce a multi layer structure which comprises more than 4 layers with one reinforcement element.

Furthermore the shown arrangement has the advantage that the thickness of the layer is

very exact and constant around the whole circumference so that the mechanical characteristics of the hollow profile member are constant around the circumference thereof. This is in particular important if the hollow profile member is used as a tube or tubing in order to conduct a gas or a liquid which has a high pressure.

Furthermore it is obvious that for laminating the reinforcement element different types of plastics, plastic-fiber mixtures or also specific plastic-locking material mixtures can be used.

An advantages embodiment consists in that the inner layer 26 and/or the outer layer 25 is comprised of a ethylene-vinyl-alcohol-copolymer so that the corresponding layers are then acting as gas impervious blocking layers.

It should be referred to the fact that the described extrusion process is not limited to a reinforcement element which has a circular cross section. It is also possible to manufacture hollow profile members having a quadratic cross section, hollow profile members having a rectangular cross section or any other cross section shape.

With the extrusion plant 1 as shown in Fig.1 in principle three extrusion units 15, 16 and 17 are used. However, for a person skilled in the art it is also obvious that more than three extrusion units can be used and that for example a fourth extrusion unit can be connected to the extrusion unit 15 in order to apply through a second hollow space formed within the traction head 11 from inside a further special layer on the lamination.

The closing station 12 furthermore can also be comprised of a welding station which includes a succeeding grinding station in order to weld the finally finished reinforcement element along the oppositely arranged longitudinal rims thereof. In may situations it is sufficient to not continuously realize the welding operation but only dot like at predetermined distances.

The strip like blank 4 can be comprised of a sheet, stainless steel sheet, aluminium, copper or any other metal, but can also be comprised of a wire mesh or of a reinforced texture.

In view of the fact that according to the inventive method a reinforcement element having a comparatively great cross section area can be embedded into a plastic material there exists now also the possibility to use the reinforcement element in order to transmit electrical signals through the hollow profile member so that a reinforced hollow profile member which has been manufactured according to the present invention can realize two functions that are on the one hand can be used as a pipe system to transfer a gaseous medium and on the other hand can be used as an electrical transmission system in order to transmit electrical signals or current (supply current).

All technical details which have been described and which are shown in the drawings are of importance for the subject invention.

CLAIMS

1. A method for manufacturing reinforced hollow profile members, according to which a longitudinal reinforcement element is introduced into an extrusion head and the reinforcement element is diecasted on all sides by a hardenable plastic, said method comprising the steps of

(a) a tape like blank (4) provided with through holes (28) is rolled within a rolling station (5,6,7) into a predetermined desired cross section shape, wherein the longitudinally extending rims of the so finally formed reinforcement element (4) are opposing one the other or contacting each other,

(b) the finally formed reinforcement element (9) is then widened at the range of the opposing contacting longitudinal rims so as to form a slit like opening, wherein said reinforcement element (9) is elastically deformed,

(c) into said slit like opening a traction head (mandrel) (11,21,27) is introduced,

(d) the slot like widened opening of said reinforcement element (4) is then closed again,

(e) the now again opposing or contacting longitudinal rims of the reinforcement element are fixed one to the other,

(f) said reinforcement element (4) is then introduced into a mechanical guiding station (13) of the extrusion head (13,14) and

(g) one or a plurality of layers (23,24,25,26,) of plastic are extruded onto said reinforcement element (9) from outside through an outer nozzle arrangement (19,20) and from inside through said traction head (mandrel) (11,21,27).

2. A method according to claim 1, wherein the tape like blank (4) is straightened within a straightening station (3) before the deformation thereof within said rolling station (5,6,7).

3. A method according to claim 1 or 2, wherein said tape like blank (4) is drawn off from a stock bobbin (2).

4. A method according to one of claims 1 to 3, wherein said tape like blank (4) is comprised of a sheet strip having a plurality of opening rows.

5. A method according to claim 4, wherein the longitudinal rims of the tape like blank (4) are provided with engaging projections (30) and engaging recesses (29) associated to the engaging projections.

6. A method according to one of claims 1 to 4, characterized in that the longitudinal rims of the finally formed reinforcement element (9) are welded together.

7. A method according to one of the preceding claims, wherein a first innerplastic layer (24) is introduced through an outer nozzle arrangement (19) through the through holes (28) of said reinforcement element (9) onto the inner wall surface of the reinforcement element

(9) and wherein said inner plastic layer (24) is shaped by means of a traction head (mandrel) (11,21,27).

8. A method according to one of claims 1 to 7, wherein the first outer plastic layer (23) and the first plastic inner layer (24) are formed from the same plastic material and wherein a second plastic outer layer (25) and a second plastic inner layer (26) are comprised of the same plastic material.

9. A method according to claim 8, wherein said plastic of the first inner layer (24) and of the first outer layer (23) is different from the plastic of the second inner layer (26) and the second outer layer (25).

10. A method according to claim 9, wherein the plastic of the first inner layer (24) and of the first outer layer (23) is comprised of a fiber-plastic mixture.

11. A method according to claim 10, wherein said fiber-plastic mixture contains wood fibers or glas fibers or textile fibers or metal fibers or mixtures from said fibers.

12. A method according to one of claims 8 to 11, wherein the second outer layer (25) and/or the second inner layer (26) are formed from a gas impermeable material

13. A method according to claim 12, wherein said gas impermeable material is comprised of ethylene-vinylalcohol-copolymer.

14. A method according to claim 1, wherein said tape like blank (4) is rolled into a circular or into a rectangular cross section shape.

15. A method according to claim 4, wherein said tape like blank (4) is provided with a plurality of side-by-side arranged opening rows extending in the longitudinal direction of said blank and wherein the through holes of one row are displaced in longitudinal direction with respect to the through holes of another through hole row.

16. A device for carrying through the method according to one of claims 1 to 15, comprising means for introducing a reinforcement element into an extrusion head, wherein in said extrusion head injection nozzles are arranged so as to diecast the reinforcement elements from all sides with plastic, said device comprising

an extrusion plant (1) having a straightening station (3) at the inlet end thereof in order to straighten a tape like blank (4), a rolling station following said straightening station (3) and having a plurality of angularly displaced pairs of rolls (5,6,7), a widening station (8) following said rolling station in order to slot like widen the finally formed reinforcement element (9) with an elastical deformation thereof, a traction head (mandrel) (11) introduced into the slot like opening, a closing station (12) following said widening station (8) to close the reinforcement element (4), which was brought into the desired cross section shape, along the longitudinal rims thereof, a following guiding station (13) having a plurality of guiding elements (31) which are engaging said reinforcement element (9) from outside and circumferentially distributed so as to guide said reinforcement element in a desired ideal position, and an extrusion head (14) having several nozzles (19,20,) succeeding in the longitudinal direction, wherein the head portion (21) of the hollow traction head (mandrel) (11,21,27) is arranged at the range of said nozzles (19,20).

17. A device according to claim 16, wherein said traction head (mandrel) (11) is guided upstream said nozzles (19,20) at the inner wall of said reinforcement element (9).

18. A device according to claim 16 or 17, wherein said traction head (mandrel) (11) has a tube or trough like recess (23') at a front portion and extending in circumferential direction into which the plastic is penetrating injected from outside through the through holes (28) of said reinforcement element (9).

19. A device according to one of claims 16 to 18, wherein said traction head (mandrel) (11) has an end portion (21) having a smaller outer dimension (diameter).

20. A device according to claim 16, wherein said guiding elements (31) of said guiding station (13) are comprised of rotatably mounted gear like disks having circumferentially distributed teeth (32) engaging from outside into said through holes (28) of said reinforcement element (9).

21. A device according to claim 20, wherein a plurality of rotatably mounted gear like disks (31) are arranged in succession in longitudinal direction and are engaging into said reinforcement element (9).

22. A device according to claim 16 wherein said closing station is comprised of a welding station.

23. A device according to one of the preceding claims, wherein said reinforcement element is used as an electrical conductor for transmitting electrical signals and electrical current.

24. A method for manufacturing reinforced hollow profile members, the method being substantially as hereinbefore described with reference to the drawings.

25. A device for manufacturing reinforced hollow profile members, the device being substantially as hereinbefore described with reference to the drawings.

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